Automated Irrigation System with Soil Moisture Detection

**Project Overview**

The objective of this project is to design and implement an automated irrigation system that leverages soil moisture sensors to optimize water usage. The system will utilize wireless communication modules and a central Laravel-based web portal to monitor and control irrigation activities across multiple farms. The following report details the system's architecture, components, and cost analysis.

**System Architecture**

**Components and Devices**

1. **Central Control Center**
   * **LS-R324 Controller**: Manages communication with field controllers.
   * **Server**: Runs the Laravel web portal and database.
2. **Pump Station**
   * **LS-RDIO0202 Module**: Controls the pump based on signals received from the central control center.
3. **Field Setup**
   * **LS-SVC04 Valve Controller**: Controls up to 4 solenoid valves.
   * **Solenoid Valves**: Manages water flow to different irrigation zones.
   * **Moisture Sensors**: Detects soil moisture levels and reports data to the Laravel system.
   * **Solar Panels (Optional)**: Powers field controllers.
   * **Miscellaneous Hardware**: Includes cables, connectors, and mounting equipment.
4. **Communication**
   * **Wireless Communication**: Facilitates data exchange between sensors, controllers, and the central system.

**Detailed System Operation**

**Central Control Center**

1. **LS-R324 Controller**
   * **Function**: Acts as the master controller, coordinating signals between the central server and field controllers.
   * **Cost**: USD 75
2. **Server**
   * **Function**: Hosts the Laravel web portal, API endpoints, and database.
   * **Cost**: Variable (based on hosting provider and server specifications)

**Pump Station**

1. **LS-RDIO0202 Module**
   * **Function**: Controls the pump operations, switching it ON/OFF based on commands from the LS-R324 controller.
   * **Cost**: USD 60

**Field Setup**

1. **LS-SVC04 Valve Controller**
   * **Function**: Controls up to 4 solenoid valves, managing irrigation zones.
   * **Cost**: USD 130 (includes 5000mAh lithium battery and enclosure)
2. **Solenoid Valves**
   * **Function**: Manages water flow to different sections of the farm.
   * **Cost**: USD 20 each (4 valves = USD 80)
3. **Moisture Sensors**
   * **Function**: Detects soil moisture levels and sends data to the central server via wireless communication.
   * **Cost**: USD 30 each (assuming 4 sensors per setup = USD 120)
4. **Solar Panels (Optional)**
   * **Function**: Powers field controllers, reducing dependency on external power sources.
   * **Cost**: USD 50
5. **Miscellaneous Hardware**
   * **Cables, Connectors, and Mounting Hardware**
   * **Cost**: USD 50

**Software Integration**

1. **Laravel Portal Development**
   * **Backend Development**: Implement controllers, models, and jobs/queues to handle irrigation logic.
   * **API Development**: Create API endpoints for moisture sensors to report data and for controllers to receive commands.
   * **Frontend Development**: Design a dashboard for monitoring and controlling the irrigation system.
2. **Database Setup**
   * **Function**: Stores data on soil moisture levels, irrigation schedules, and system configurations.
   * **Cost**: Part of the overall software development budget.
3. **Monitoring and Alerts**
   * **Function**: Tracks system performance and sends alerts for low moisture levels or hardware malfunctions.
   * **Cost**: Part of the overall software development budget.

**Cost Analysis**

**Hardware Costs (per Field Setup)**

1. **Central Control Center**
   * LS-R324 Controller: USD 75
2. **Pump Station**
   * LS-RDIO0202 Module: USD 60
3. **Field Setup**
   * LS-SVC04 Valve Controller: USD 130
   * Solenoid Valves (4): USD 80
   * Moisture Sensors (4): USD 120
   * Solar Panel (Optional): USD 50
   * Miscellaneous Hardware: USD 50

**Total Hardware Cost per Field**: USD 445

**Software Development Costs**

1. **Laravel Development**
   * **Total**: USD 300,000

**Total Software Cost**: USD 300,000

**Overall Cost for a Single Complete Installation**

* **Hardware Cost**: USD 445 per setup
* **Software Development Cost**: USD 300,000
* **Total Cost**: USD 300,455

**Implementation Steps**

1. **Hardware Installation**
   * Install LS-R324 controller at the central control center.
   * Set up LS-RDIO0202 module at the pump station.
   * Deploy LS-SVC04 valve controllers, solenoid valves, moisture sensors, and solar panels (if used) in the field.
2. **Software Development**
   * Develop the Laravel web portal and integrate it with the hardware components.
   * Set up the database and configure API endpoints for communication between sensors, controllers, and the central system.
3. **System Testing and Deployment**
   * Test the entire system for proper functionality and reliability.
   * Deploy the system to the live environment and conduct final checks.
4. **Monitoring and Maintenance**
   * Continuously monitor the system and address any issues promptly.
   * Provide maintenance and updates as needed.